DEVELOPMENT OF DISCRIMINANT MODEL FOR CLASSIFYING JUMPERS AND SPRINTERS ON THE BASIS OF ANTHROPOMETRIC, BIOMECHANICAL AND PHYSICAL VARIABLES

By

DAYA VIR SINGH

A

SYNOPSIS

Submitted to

Department of Sports Biomechanics

Lakshmibai National Institute of Physical Education, Gwalior,

(M.P.)

DOCTOR OF PHILOSOPHY

in

PHYSICAL EDUCATION

SUPERVISOR

DR. VINITA BAJPAI MISHRA

SUBMITTED BY

DAYA VIR SINGH

Department of sports biomechanics

Certificate

I hereby declare that the short synopsis **"Development Of Discriminant Model For Classifying Jumpers And Sprinters On The Basis Of Anthropometric, Biomechanical And Physical Variables"** being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Physical education under the department of sports biomechanics of Lakshmibai National Institute Of Physical Education Gwalior 2022-23.

It is a bonafide record of original work carried out under the supervision of Dr. Vinita Bajpai Mishra and has not been submitted in full or part to anyother university or institute for a degree or diploma. Further, it is certified that the short synopsis is plagiarism-free and the proof has been submitted.

(DAYA VIR SINGH)

DR. VINITA BHAJPAI MISHRA

(HOD of sport biomechanics)

(Chairman,DRC)

TABLE OF CONTENTS

Chapter	Contents	page no
I	**INTRODUCTION**	**1-14**
	Statement of the Problem	12
	Objectives of the Study	12
	Hypothesis	12
	Research Questions	12
	Delimitation	13
	Limitation	13
	Definition and Explanation of Terms	14
	Significance of the Study	14
II	**REVIEW OF RELATED LITERATURE**	**15-21**
III	**RESEARCH** METHODOLOGY	**22-26**
	Selection of Subjects	22
	Selection of Variables	23
	Criterion Measures	23
	Administration of Tests and Collection of Data	24
	Statistical Technique	25
	Bibliography	**27**

ABSTRACT

Sprinting refers to running over a short distance at the highest possible speed. It is a high-intensity, anaerobic activity that relies on explosive power and speed. And Jumping is the act of propelling oneself off the ground into the air using the muscles of the legs and feet. It is a fundamental movement in many sports and physical activities. Aim of study is to development of discriminant model for classifying jumpers and sprinters on the basis of anthropometric variables, biomechanical variables and physical variables. Material and methods out of sixty six athletes thirty three are jumpers and thirty three are sprinters all the participants will be state level players. Collection of data would be done on different variables like anthropometric that is height, arm length, leg length, foot length, and biomechanical variable i.e. Take off force, impact force and physical variable i.e.Leg explosive power, speed. Collection of data for anthropometric and biomechanical will be done in laboratory and physical variable on ground. Statistical analysis will be done by using discriminant analysis would be used to find out result. Conclusion a model can be prepare on the basis of anthropometric variable another can be prepare on the basis of biomechanical variable and third model can be prepare on the basis of physical variable

Keywords: jumpers take off force, sprinters leg length, jumper's impact force, jumper's maximum concentric power.

CHAPTER-I

INTRODUCTION

Humans are naturally inclined to run, leap, and throw. Track and field has been a feature of human culture since the dawn of civilization. In actuality, they are the innate behaviors that are inherent to every individual. One has to develop these skills in order to thrive on Earth.Sports performance has reached unprecedented heights in the modern era. In their respective sports, a large number of athletes frequently set new world records. In practically every sector, the pursuit of excellence has extended around the world. The importance of scientific research in reaching these new heights cannot be denied. Numerous studies are being carried out to treat the most prevalent sports-related disorders.To take sports to the next level, researchers are looking at developing training programs, equipment, fabrics, textiles, and so on. To satisfy the highly unique requirements of a given sport, many types of shoes have been developed. In the past, athletes were accustomed to going barefoot, but today they are given specific running shoes that can help them run more effectively.

Finding talent at a young age is an essential first step in achieving height in any sport. Athletes that begin participating in a sport early get quite acclimated to the activity's extremely subtle motor movements. Training those fine motor skills later in life is nearly difficult. Humans lose their capacity to acquire so-called challenging sports talents as they become older. It is common if somebody is trained in some kind of sports for a long time it makes him able to acquire average playing ability of that particular sports or game

Regardless of the individual trainability component, it is feasible. For this reason, it is essential to identify a child's ability early on in their development. Numerous hypotheses about science and other fields have been discovered since the start of the twenty-first century. Numerous innovations and discoveries have been made in the modern scientific community. Every day, the ideas are contested, giving rise to new ones that either refute the older ones or support them and advance them.

To succeed in several sports, one has to have particular anthropometric traits. It's also critical to recognize that athletes who participate in team sports and individual sports have somewhat different body compositions and structures. Some sports, like shot put and high jump, have very specialized duties that differ from one another and the successful

physiques. "Morphological optimization" is the process by which the physical demands of a sport determine which body types are most appropriate for that sport(Bloomfield et al., 1995).Jumping is the act of propelling oneself off the ground into the air using the muscles of the legs and feet. It is a fundamental movement in many sports and physical activitiesMcGinnis, P. M. (2013). Sprinting refers to running over a short distance at the highest possible speed. It is a high-intensity, anaerobic activity that relies on explosive power and speed Earle, R. W. (2008)

History of Athletics

Athletics is a group of sporting activities that include running, throwing, and leaping. It is often referred to as track and field athletics. An athlete is a person taking part in these activities; however the phrase can also apply to physically fit individuals in many related sports. The Greek word "Athlon" is where the term originates “contest."Some languages, like German and Russian, call these games "light athletics" in order to distinguish them from other sports like wrestling, weightlifting, and so on. Running, walking, leaping, and throwing competitions are some of the oldest sports, with ancient origins. Ancient Egyptian tombs at Saqqara had depictions of athletic activities dating back to 2250 BC, including high leaping and sprinting during the HebSed festival.Running and stone-throwing were two of the sports events during the thirty-day Tailteann Games, an ancient Celtic festival that was established in Ireland about 1800BC. The stadion, a stadium-length running competition, will be the first and only event in the first Olympics in 776 BC. Later, this was extended to include the ancient pentathlon's throwing and leaping competitions. Additional PanHellenic Games, which were established later, about 500 BC, also featured athletic activities.Sledgehammer throwing competitions were another aspect of the Cotswold Olympic Games, a sporting event that originated in England in the 17th century. The 'Olympiad de-la Republic, an early precursor to the contemporary summer Olympic Games, would take place in revolutionary France every year from 1796 to 1798. A running race will be the competition's main event, although there were also displays of other ancient Greek sports. The metric system was first used in the sport at the 1796 Olympiad.The stadium-length foot race, or stadion will be the sole event in the first Olympics in 776 BCE, and athletics will be the original event. Traditionally, only young males were allowed to compete in the ancient Olympics. Due to the suitable weather and the fact that the event is intended to be a celebration of the accomplishments of the human body, competitors were typically nude.A later athletic event in the Olympic Games and

other PanHellenic Games of Ancient Greece is the pentathlon. It comes from the Greek language meaning "five competitions." The long jump, javelin throw, and discus throw were not staged as a combined competition, while the stadion and wrestling were also held as separate events. Since pentathletes were regarded as among of the best athletes, military duty frequently included training for them; each of the five events is believed to be beneficial in combat.The wrestling and the stadium would remain separate events, but the bouts would not have to be fought should the identical man win two events, the long jump and either the discus or the javelin throw. If multiple athletes win all the events, the one who wins the most games is called the stadium champion and is often used as a shorthand for the overall games champion, especially in the early games.

The Celts, Teutons, Goths and other races have also delighted in games of strength and skill. Some of these were related but were related to combat training. In medieval times the training of noble boys who grew up in castles and had the means to attack or defend them would all have also been educated in running, leaping and wrestling - along with riding, jousting and arms-training. It is likely that competitions between rivals (and perhaps friends) were, on all official and unofficial levels, quite common.The modern process of organizing and becoming more systematic started in the 19th century with the first national running competition in England in 1825. Schools also started integrating the practice of regular sports and exercise into their schedules. This was first introduced at the Royal Military College, Sandhurst in 1812 following a request in 1808 again, in 1825 with reclaimed land at the front. These claims are believed to be without foundation. The first recorded will take place in Shrewsbury, Shropshire in 1840 by Royal Shrewsbury School Hunt.There are descriptions of the meeting in a series of letters penned 60 years later by C.T. Robinson who is to be a pupil at the establishment from 1838 to 1841. British the Royal Military Academy, Woolwich held a meeting in an organized competition in 1849, but it will be in 1850 at the earliest that the first annual series of meetings have been proposed by Exeter College, Oxford. The first regatta to be open to all amateur watermen, it will be held in 1861 under the auspices of the West End Rowing Club.The first English championship games held in 1866 by the Amateur Athletic Club (AAC), emphasized the social aspect of its participants, the unpaid "gentlemen amateurs". The AAC will be superseded as the senior controlling sports body in 1880 by the Amateur Athletic Association. The Panathenaic Stadium, dating to about the 4th century B.C., is to be renovated for the 1896 Olympics and renovated again for the 2004 Summer Games.(The field events—vaulting, jumping, and throwing— most

frequently occur within the track.) Athletics remain his backbone since they will be part of the first modern Olympic Games, in 1896. The new Olympics were a hit at first, but then they stumbled. uery137-141>>, pg137-141 When they had been part of a larger event at Paris.(1900) and St. Louis(1904) the celebrations had been overshadowed by the World's Fair they appeared in.The Intercollated (in between) Games avi vii were to be a continue of the twelve-year cycles of the Olympic Games, the first organized XI Olympiad still as part of the 1908 Olympics held in London. While officially the IOC officially recognized and endorsed the games, the games are not recognized by the IOC as being an official Olympic Games, leading to the suspicion that it was an attempt to mark the tenth anniversary of the modern Olympics.The 1906 Games also marked the rise of a greater international presence at the games, as initially this was considered a "United States" sport, with 80 percent of participants being American in 1904, the 1906 games it was the reverse, and public interest in the Games also began to generate more interest in future games. It wasn't until 1928 that Olympic organizers began letting women compete in track and field.The number of athletes participating at the Summer Games rival evens the number at the Summer Olympics: the record of 10,942 athletes who competed at the 2004 Summer Olympics in Athens was almost doubled in scale by the 2012 Paralympic Games. The number of participants is much less than the Summer Olympics; for example, 2,633 athletes representing 80 nations participated in 84 events in the 2006 Winter Olympics in Turin Italy.International world governing body, the International Association of Athletics Federations IAAF will be established in 1912. The IAAF introduced the separate outdoor World Championships in 1983. There are also other regional games, such as the European Championships, the Pan American Games, and the Commonwealth Games.There is also a professional Golden League circuit, which culminates in the IAAF World Athletics Final, as well as indoor events like the World Indoor events. The sport receives a lot of attention at big tournaments, particularly the Olympics, but it is not as popular elsewhere. Track and field now has two seasons: an indoor season, which runs during the winter, and an outdoor season, which runs in the spring and summer.Many high schools and universities feature track and field activities and facilities (mostly outdoors), with local, state and regional competitions. Athletes can now receive money for track and field competition, putting a stop to the so-called "amateurism" that existed previously.

.

Four to six lanes are consisted by 200m indoor tracks.Banked corners are commonly used on indoor tracks to compensate for tight curves. In an indoor track meet, athletes compete in the same track events as an outdoor meet, with the exception of the 100 m and 110 m/100 m hurdles (replaced by the 60 m sprint and 60 m hurdles at most levels, and sometimes the 55 m sprint and 55 m hurdles at the high school level), as well as the 10,000 m run, 3000 m steeplechase, and 400 m hurdles.Indoor meetings also include a 3000 m run at the collegiate and elite levels instead of the 10,000 m. The 5000 m is the longest event generally conducted indoors, however larger distances have been completed. In the mid-twentieth century, there will be a series of "duel races" in Madison Square Garden's (NY) indoor track, with two men racing a marathon (26.2 miles). However, this is an incredibly uncommon event for obvious reasons. In certain situations, there may also be a 500 m race instead of the open 400 m generally found outdoors, and in many collegiate championship indoor events, both are contested.

Indoor matches only include field events such as the high jump, pole vault, long jump, triple jump and shot put. Longer javelin, hammer, and discus throws are only added for outdoor meets since indoor stadiums typically do not have the room to accommodate these events. Other events unique to indoor meets (especially in North America) include the 300, 600, 1000, and 35-pound weight throws.In certain nations, like Norway, the standing long jump and standing high jump are also competed in at the National Championships. Indoors, multi-event athletes can compete in the Pentathlon for women (60 m hurdles, high jump, shot put, long jump, and 800 m) and the Heptathlon for men (60 m, long jump, shot put, high jump, 60 m hurdles, pole vault, and 1,000 m). Outdoor events include the heptathlon for women and the decathlon for men.

In 1912, the International Amateur Athletics Federation (IAAF) was established as the international governing body for athletics. The IAAF later changed its name to the International Association of Athletics Federations in 2001. In 1983, the IAAF established separate outdoor World Championships. Today, athletes can earn money for racing, putting an end to the so-called "amateurism" that existed in the past.It would be known originally as the International Amateur Athletics Federation, but its name was eventually altered to reflect the sport's shift from amateurism to professionalism in the late 1970s. The IAAF has 213 member nations and territories organized into six continental areas (or area associations). The six association regions are Asia, Africa, Europe, Oceania, North America, and South America. Athletics sports do not have independent governing bodies

at the international or continental levels; instead, they are all overseen by athletics authorities. The map depicts the six continental federations of the IAAF.

"AAA – Asian AthleticsAssociation"

"CAA – Confederation of AfricanAthletics"

"CONSUDATLE – South American AthleticsConfederation"

"NACACAA – North America, Central America and Caribbean AthleticAssociation"

"EAA – European AthleticsAssociation"

"OAA – Oceania AthleticsAssociation"

National athletics organizations are in charge of regulating the sport within their respective countries, and most major competitions have some form of permit or approval from their national body. Films about athletics are overwhelmingly focused on running events: the 1962 film, The Loneliness of the Long-Distance Runner (based on the book of the same name), explores cross-country running as a means of escape; Chariots of Fire, perhaps one of the most well-known. Track and field wouldhave been the subject of American films such as *Personal Best* (1981) and *Across the Tracks* (1991). The category includes biopics, like Prefontaine (about Steve Prefontaine) and Jim Thorpe. All American (1951), starring Burt Lancaster as Thorpe. Documentaries are also common, with examples including the 2007 film Spirit of the Marathon, which follows runners as they prepare for the 2005 Chicago Marathon. Books on the subject are primarily nonfiction, taking the form of training manuals and historical descriptions of athletics. The narrative of the four-minute mile has been a particularly popular topic, inspiring publications such as The Perfect Mile and 3:59.4: The Quest to Break the Four Minute Mile

Athletics inIndia

The history of Indian sports may be traced back to the Vedic period. Although it is definitely a question when exactly athletics in India made its presence felt as a unique sporting activity, it may be stated that the well-illustrated ideals of the Atharva Veda shaped thelimn of Indian athletics.Athletics were a popular kind of sport throughout the Vedic period, as well as later in the Ramayana and Mahabharata. Chariot racing, archery, horsemanship, military tactics, wrestling, weightlifting, swimming, and hunting were all popular sports during the time. Historical evidence reveals that Indian sports developed a unique depth while Buddhism maintained control in India.Many exciting sporting events, like archery, horseback riding, and chariot racing, were popular throughout that time. Aside from these activities, additional games such as trekking, strolling, and 'gulli-danda'

emerged later in ancient India. Almost all of these games were considered a'must' in the Indian empires' military training sessions at the time. With the course of time, the nature and structure of sports in India started to alter. During the mediaeval time in the history of Indian athletics, Indians began performing sports including running, leaping, and throwing, among others.

The majority of these sports were forerunners of the track and field disciplines that we see today. All of these activities were quite popular in India because they could help people improve their physical fitness. In the early years of Indian independence, modern versions of track and field sports became more popular and organized. Until then, Indian athletics had gone through several phases. Games were first played on grass and cinder tracks, before gradually transitioning to synthetic tracks. The latter adoption of technology into athletics elevated its standing further by making it much easier to keep track of players' time.Athletics will be being played in an unorganized manner in India till Independence and it will be in 1946, when Indian athletics started to be managed in an organized manner. The decade of 1940s and 1950s are most notable in the history of Indian athletics, as a number of athletics associations started their journey in India, during that period. In 1946, the Amateur Athletics Federation of India (AAFI) will be established for the management of Indian athletics. It worked in collaboration with other athletics associations for improving the entire scenario of Indian athletics.

Indian athletes have made their presence felt in several international tournaments, and India has so far produced a number of successful athletes at the international level, as well as some other budding athletes who show signs of becoming successful in international tournaments in the near future. Athletics has shown a continuous trend of improvement so far, and it is also showing some promising signs for the future.An athlete's performance in sports is determined by various aspects other than motor fitness, including scientific excellent quality equipment, clothing, training plan, competition frequency, psychological preparation, and a balanced nutrition. All of these variables help to prepare the athlete for the competition. Apart from that, he must acquire motor fitness.According to research findings, great levels of technical perfection alone do not produce success in competitive sports. Most games need a higher level of fitness from the competitors.

.

Throwers have a higher body weight because throwing an object forward and upward exerts an equal and opposing force on the thrower, disrupting his body equilibrium. As a result, the impact of this reaction will be greater if the athlete does not have a substantial

body weight. Furthermore, increased height is useful for sportsmen since it allows the throwing tool to fly longer in the air (Sodhi, 1991).

Similarly, height provides an advantage to basketball and volleyball players. Height contributes to their greatness and is an advantage for these athletes. On the other side, shorter heights are more beneficial to gymnasts, which is why China, Korea, and Japan have produced more gymnastic athletes. Their tiny body physique has allowed them to succeed in gymnastics, weightlifting, and the light weight division of boxing. Europeans are taller; hence European nations have demonstrated their athleticism in volleyball, basketball, swimming, long jump, and shot put. Bulky musculature allows athletes to excel in throwing events and the heavy weight class in boxing.Motor fitness is not only necessary, but also serves as the foundation for a healthy lifestyle. Fitness cannot be ignored in favour of talent and technique. Nowadays, an athlete must be physically "extra fit" in order to face the severe competition. In terms of physical culture, education, and yoga asana, the Athenians and ScandinaviansMotor fitness is a crucial part of overall fitness. The term'motor fitness' encompasses more than just physical strength and endurance. It indicates effective performance in exercise or labor at a fair level of ability in the performance of specified physical activities.Borrow and McGee (1971)described the term “physical fitness as a broader concept which included motor fitness”. Devris (1974) also supported the view of Barrow and McGee (1971) and advocated that“physical fitness includes both motor fitness and physical working capacity. Three components of physical fitness i.e. muscular strength, muscular endurance and cardio-respiratory endurance were described as commonly accepted elements of fitness, other components which are often identified as elements of physical fitness are muscular power, agility, speed, flexibility andbalance”.

The body of an athlete may impact the technical and tactical side of the game. Training, physical activity, environment, and diet cannot affect an athlete's segment length. So far, efficient execution, appropriate changes in technique and tactics based on one's segment size and structure, may be useful at times throughout the game. Coaches and athletes may use it tactically on occasion. Speed, strength, evidence, agility, and coordination are all intertwined in the evolution of body structure.The magnificent development in these fitness abilities seemsto finally determine the performance at any level of contestinsports.Studies on the physical characteristics of the human body till date indicate that the morphological characteristics of athletes successful in a specific sport differ in somatic characteristics from the general population. Each person has distinct physical

traits. The breadth of human variety is so great that no two people are similar. With such a wide range of human physiques, it is commonly recognized that some sporting activities are more suited to people with specific body types than others. Specific physical features such as body composition, size, type, and structure are thought to be important variables in improving high-level performance in a variety of sports.To the physical educator, coach, and sportsman, an understanding of physical characteristics and the dynamic of motor fitness are becoming increasingly important because motor fitness is the capacity to do prolong hard work and recover to the same state of health in the shortest amount of time.This is the reason of the degree of strength, speed, endurance, agility, power and flexibility one possesses. More recently, several studies on Olympic athletes have revealed that different sports events differ not only in their skill patterns, organization, and equipment requirements, but also in the anatomical structure (body build) of the athletes competing in them. For example Basketball players are normally tall; the weightlifters are stocky whereas the throwers are more muscularDe Gary et al. (1974).The contents of sporting events are grouped according to the primary qualities of each type of event required or produced. Participants in different games and sports activities possess or require distinct attributes to be successful in that specific event.

.

Statement of theProblem

Development of discriminant model for classifying jumpers and sprinters on the basis of anthropometric, biomechanical and physical variables.

Objective

To develop discriminant model for classification of jumpers and sprinters on the basis of selected anthropometric, biomechanical and physical variables.

Research Questions

- Whethersubjects could be classified in either category on the basis of selected physical, anthropometric, and biomechanical variables?
- Which predictor variable has more discriminating power for classification of jumpers and sprinters?

Hypotheses

Based on literature gone through, research findings and Scholar's own understanding of subject area, the hypothesis will be formulated as:

- A discriminant model can be developed on the basis of anthropometric, biomechanical, and physical variables.
- The developed discriminant model will be significant.

Delimitations

- Study will be delimited to the state Level player of India only.
- The present study will be delimited to age ranged 18-22 years only.
- This study will be delimited to male subjects only.
- The present study will be delimited to jumpers and sprinters in athletics.
- The bifurcation of track and field athletes will be as follows:
  - **A.** 33 sprinters of 100 meter event.
  - **B.** 33 jumpers of long jump.
- The present study will be delimited to following predictor variables only:
- **Biomechanical Variables**
  - A.CMJ with Arms Thrust Height (CMJAT)
  - B. CMJ with Arms Thrust Take off force
  - C. CMJ with Arms Thrust Impact Force (k N)
  - D. CMJ with ArmsMaximum Concentric Power (kw)
  - E. CMJ with Arms Thrust TakeoffSpeed (m/s)
- **PhysicalVariables**
  - A. Speed
  - B. Agility
  - C. Leg Explosive strength
  - D. Shoulder Explosivestrength
- **Anthropometric Variables**
  - A. Leg Length
  - B. Standing Height
  - C. ArmLength
  - D. Foot Length
- Study will be delimited to the male state levelPlayer of India

Definition and Explanation of terms

Physical Fitness:

It can be defined as "state of health and well-being and more specifically the ability to perform aspects of sports, occupations and daily activities".

Anthropometry:

"Anthropometry refers to the measurements of human body. It involves the systematic measurements of physical properties of human body, primarily dimensional descriptors of body size and shape".

Trackers:

"Athlete who take part in running events of the Track and field sports".

Jumpers:

Athletes who take part in various jumping events of track & field. That is long jump, triple jump, high jump etc.

Significance of the study

- The present study will help in special importance to the coaches who are looking for talent identification of long jumpers and 100m sprinters.
- The present study will help athletics professionals in figuring out the most important predictor variables which have maximum discriminant power for long jump and 100m sprint.
- If such discrimination is done at the early stage of training the future athletes could attain new heights in the international arena.
- The present study can be highly beneficial to track and field coaches in designing the separate training program for sprinters and jumpers.
- Early detection of hidden talent can help the nation in bringing out new talent in main stream. This can be fruitful in later stage of training.

CHAPTER-II

Review of Related Literature

A review of related literature was conducted in accordance with the study's goals. Various studies that have been conducted serve as a guideline not only to give knowledge about the amount of work that has previously been done in the area, but also to highlight the gaps and lacunae that still remain in the relevant field of study.The literature, which is stored in the form of books, monographs, and journals, among other things, proves to be a great help when it teaches us how to collect necessary information about the problems, statistical techniques used, and the obvious outcomes of previous researchers.

Studies Related to Athletic Performance

Chauhan, M.S., (2003) did a study on relationship between anthropometric variables and middle running performance and brought about the height, linear measurement i.e., age, thigh length, leg length, shoulder chest abdomen hip, ankle diameter, thigh knee girths, and calf skin fold have positive and significant correlations. The multiple correlations of anthropocentric variables such as height, thigh girth, biacromial diameter, and thigh skin fold with middle distance running performance is significant at the.01 level, but the multiple correlation is insufficient, so the regression equation cannot be used to predict running performance.

Chauhan(2004) inhis study "The regression equation for the prediction of performance of university throwers in relation to their anthropometric measurements"Thirty-two throwers from Kurukshetra University's University Athletic Meet were chosen as subjects, and their body measurements were taken using an anthropometer, steel tape, vernier caliper, and skin fold caliper, in accordance with Weiner and Louie's (1969) instructions. The subjects' throwing performance will be evaluated in terms of their ability to put the shot.The Product Moment Method for inter-correlation, the Wherry Do Little Method for calculating multiple correlations, and the development of regression equations for predicting performance were used. Height, leg length, fore-leg length, total arm length, upper and forearm length, circumferences (shoulder, chest, abdomen, hip and arm), body diameters (biacromial, bicristal, and elbow diameters), and skin fold measurements (biceps, subscapular suprailiac, and calf skin folds) were found to have positive and significant correlations with throwing performance at the 1% and 5% levels, respectively. At the 5% level, body density shows a negative and significant link with throwing performance, but fat percentage, fat weight, and lean body mass have positive

and significant relationships.The association between body weight, height, and total arm length and throwing performance is positive and very significant (R=.935). The magnitude of the various correlations is sufficient; therefore the regression equation produced may be utilized to forecast athletes' throwing performance.

Kruger (2004) worked with javelin throwers. The goal of this study will be to characterize the body composition and somatotypes of international male elite javelin throwers and to discover which characteristics separate the world's elite javelin throwers from the sub elite throwers and which variables contribute to their performance. Elite javelin throwers had an average body mass of 97.0kg, a height of 187.5cm, a percentage body fat of 11.9%, and a percentage muscle mass of 40.4%. The javelin throwers had an average skeleton mass of 11.2kg, which was represented as 11.7%.The forearm 28.7 cm will be 35.5 cm with average humerus length. The Javelin throwers have an average bi-iliocristale breadth of 31.9cm, bi-acromial breadth or 45.5 cm. The average wrist width is 6.0 cm, the ankle width is 8.1 cm, the femur width is 10.2 cm, and the humerus width is 7.4 cm. Javelin throwers had an average flexed girth of 38.3cm, forearm girth of 30.5cm, thigh girth of 64.1cm, and calf girth of 40.8 cm. The average sometotype among javelin throwers was 2.5-5.9-1.4. The best discriminant variables between the two groups were age ($F = 10.53$, $P<0.05$), body mass ($F = 3.97$), and % muscle mass ($F = 2.33$).

Sumanta et al. (2008)worked on 17 shot putters, 10 hammer throwers, 15 javelin throwers and 11 discus throwers who participated in the 64th All India Inter University Athletic Meet held at Jamshedpur in the year 2004 and crossed the qualified standards of 12 meters in shot put, 38 meters for discus throw and hammer throw and 55 meter in javelin throw. They took 14 anthropometric measures, including height, arm length, upper arm length, forearm length, upper arm girth, forearm girth, chest circumference, shoulder width, leg length, upper leg length, lower leg length, thigh girth, calf girth, and percentage of fat. Only a few factors in each event were determined to be inconsequential to performance at the 0.5 level.

Pritam et al. (2009)did a study to determine the differences between distinct groups of intercollegiate male throwers and long distance runners. The research will include 120 interuniversity long-distance runners and throwers. Each subject's height, weight, BMI, and percentage of body were measured using established procedures. Long-distance runners were found to be shorter than throwers. Shot putters were found to be the tallest among throwers, followed by discus and javelin throwers. In running competitions, cross-country athletes were found to be the lightest of all classes. The highest BMI will be

observed among throwers (who were regarded overweight owing to their shorter height and heavier weight), followed by long distance runners. Shot putters have the highest BMI in throwing events, followed by discus and javelin throwers. Long distance runners will have the highest BMI at 5000 m, followed by 10,000 m, while cross country athletes would have the lowest. The proportion of fat will be highest in throwing events.

Ragad Al (2010)30 javelin throwers competed in the King Hussein Sport Championship. The study will seek to determine the association between specific physical traits and anthropometric measurements and javelin throwing performance. The study's findings revealed a statistically significant relationship between height, trunk length, arm length, forearm length, leg length, thigh length, chest perimeter, forearm perimeter, upper arm perimeter, and javelin throwing performance level. He also discovered that there is no relationship between the perimeter of the thigh, the length of the palm, and the performance level of javelin throwing.

SinghB.B. et.al (2010) The average sitting height-stature index, thigh length-lower leg length index, and upper arm length-lower arm length index of Indian elite male throwers in various throwing events were found to differ. The 25 subjects for each event (shot put, discus, javelin, and hammer throwers) were chosen from national and international tournaments, India camps, sports authority of India (SAI), and state hostels.However lower arm length upper arm length index of the four groups differ significantly.

Bagchi (2016) did a study & developed a model for 210 ((Batsmen N = 70, Spinners N = 70 and Pace - Bowlers N = 70) male cricket players.Total 12 predictor variables were taken by the researcher that is of anthropometric measurements were, stature, Ann Length, Leg Length, Hand Length and Biacromial Diameter (Shoulder Width) and physical fitness variables were, Speed, agility, Leg explosive strength, leg strength, back strength, shoulder explosive strength and hand grip strength. The researcher developed a multiple discriminant model for cricketers.The model explains that overall, 64.8% of original grouped cases were correctly classified. The developed discriminant function explains 53.14 % of variation in the two different groups of cricketers by the discriminant model. The model shows that overall, 82.1 % of original grouped cases were correctly classified.

Ivashchenko (2016) to create methodological approaches to regulate the motor and functional fitness of 14-16-year-old females. 14-year-old girls (n=31), 15-year-old girls (n=26), and 16-year-old girls (n=28) participated.We employed factorial anddiscriminant analysis to identify relevant indicators of pedagogical control on girls' motor and

functional fitness. The study's findings suggested that a factorial and functional study of children's and teenagers' motor fitness was necessary. A factorial and discriminant model of girls' motor and functional fitness serves as the foundation for improving pedagogical management in school physical culture programs.In a factorial model of 14-year-old girls' motor and functional fitness, functional fitness of the respiratory and cardio-vascular systems, coordination and power fitness, and speed-power fitness take precedence. Functional fitness of the respiratory and cardio-vascular systems takes precedence in the motor and functional fitness of 15-year-old girls. Functional fitness of the respiratory and cardio-vascular systems, power fitness, and power endurance are the top priorities for 16-year-old girls' motor and functional fitness. Furthermore, it was determined that a first discriminant function with an emphasis on the most informative variables can be used for final pedagogic control over 14–16-year-old girls' motor and functional fitness.

Bharathiraja and Palanisamy (2015)found out predominate factors in assessing batting abilities in 150 male inter- collegiate cricket players from selected physiological, kinanthropometric, and physical variables. Physiological variables included were, resting heart rate, respiratory rate and kinanthropometric parameters were, standing height, body weight, and three lengths measurements of biceps, triceps, and supraspinale by the use of skinfold caliper.The researcher concluded that biceps, triceps, resting heart rate, leg explosive power, flexibility, and maximum strength are the common parameters that can predict cricket players' batting abilities. The variables studied included flexibility, balance, muscular endurance, leg explosive strength, and maximum strength.

Tiwari (2012) evaluated the physical and physiological characteristics of inter-district and inter-state basketball players. A total of 60 male basketball players were chosen at random for the research (30 inter-district and 30 interstate). The physical measures were 39 speeds, endurance, power, and sergeant jump, while the physiological variables were vital capacity and resting heart rate. It was revealed that the inter-state level players were superior then district level players with respect to power, endurance & speed. No significant difference in case of physiological indicators between both the groups.

Needhiraja & Kalidasan (2011) found out playing ability of inter collegiate handball players on the basis of predicting variables selected from anthropometric, physical and physiological parameters. 158 players were selected for the purpose of the study. the parameters which were evaluated were Body weight, Length measurements (cm) - Standing height, Arm length, Arm span, Leg length, Hand length, Hand breadth, Palm length and Palm breadth; Breadth measurements (cm) - Humerus breadth and Femur

breadth; Girth measurements (cm) - Arm girth relaxed, Arm girth flexed, Fore arm, Chest, Waist, Hip, Thigh and Calf were selected. Physical variables namely Speed, Agility, Flexibility, Leg explosive power and Muscular strength were selected and Physiological variables namely Vital Capacity, resting heart rate, Diastolic blood pressure, Systolic blood pressure, Peak expiratory flow rate and Breath holding time. The result of the study showed that there exits relationship among selected anthropometrical, physical and physiological characteristics and playing ability among inter collegiate Handball players. Researcher also found that arm span, diastolic blood pressure, palm span, Peak expiratory flow rate, resting heart rate, palm length, flexibility, systolic blood pressure, agility, leg explosive power and breadth holding time, which can predict the playing ability in handball players.

Till et al. (2011)conducted study on junior rugby players to predict team selection using anthropometric factors. The researcher sought to determine whether there are differences in performance were VO2 max, chronological age, body mass, a 20-meter sprint, height, the total of four skinfolds, and sitting height. The researcher concluded that in both the levels performance characteristics differ. Physical attributes like 20 m sprint, only partially explain greater representative and anthropometric characteristics between regional and national level players. The study's criteria selection

Thapa et al., (2020)the drop jump is one of the most investigated plyometric workouts. Different drop heights were originally examined for ground reaction forces, biomechanical studies, and other characteristics. There has been no study on the effect of drop height on maximum leap height during drop jump in football players. This study sought to determine the ideal drop height for maximal vertical leap height in drop jumps. Material and Methods The researchers selected 17 male soccer players (mean ± SD; age 21 ± 2 years, height 174 ± 8 cm, body mass 63 ± 5 kg, isometric leg strength 122 ± ± 18 kg) for the study. Drop jump from different heights (35 cm, 45 cm, 50 cm, 65 cm, and 72 cm) was investigated for jump height, take-off force, take-off speed, impact force, maximum concentric power, and peak speed. Results: Repeated measures ANOVA revealed significant difference in jump height from different drop height ($F_{2.54, 40.59} = 5.605$, $p = 0.004$, partial $\eta 2 = 0.259$). Post-hoc analyses through Bonferroni adjustment showed significant differences between jump height from 35 cm box and 45 cm box ($t_{16} = 4.31$, $p = 0.001$, $d = 0.47$) and 35 cm box to 72 cm box ($t_{16} = 3.52$, $p = 0.003$, $d = 0.60$). However, no significant differences could be observed in take-off force, impact force, maximum concentric power, peak speed, and take-off speed from different drop heights.

Isometric leg strength were significantly correlated with jump height from 35 cm (p = 0.014), 45 cm (p = 0.021) and 50 cm (p = 0.022) drop height.Conclusions: The study concludes that to improve maximum jump ability of soccer players, box height ranging around 65 cm to 72 cm may be selected for training purposes and thus may help improve the body's ability to convert the momentum generated by a run to maximum vertical height.

Nohara, H. (1990)the purpose of this study was to ascertain how run-up speeds affected long jump takeoff technique. An elite male long jumper's seventy-one jumps were captured on a high-speed video camera in the sagittal plane. Direct intervention was used to set the athlete's run-up length, resulting in a wide range of run-up speeds. The leg angle at touchdown stayed relatively constant, the take-off angle and take-off length gradually dropped, and the athlete's run-up speed rose along with the jump distance and take-off speed. The experimental results and the predictions of two previously published mathematical models of the long jump take-off coincide fairly well

CHAPTER-III
RESEARCH METHODOLOLGY

The current study is predictive in nature, with a sample of individuals drawn from sprinters of 100m and long jumpers. Athletes competing in various sporting events at state level of competitiveness. To fulfill the objectives of this study, the investigator must organize the entire process of the work in terms of research design suitable to the study; hence, the design of the current investigation is provided systematically under the following headings: -

Selection of Subjects

The sample size willcomprised of 66 athletes who have participated atstate Level competitions, only the male players with the age ranged 18-22 years of India will be selected.The random sampling technique will be utilized to collect the required data from the different state.

Selection ofvariables

S.No	**Physical Variables**	**Biomechanical Variables**	**Anthropometric Variables**
1	Speed	CMJ with Arms Thrust Height (CMJAT)	Arm Length
2	Agility	CMJ with Arms Thrust Take off force	Leg Length
3	Leg Explosive strength	CMJ with Arms Thrust Impact Force (k N)	Standing Height
4	Shoulder Explosive strength	CMJ with Arms Thrust Maximum concentric power (k w)	Foot Length
5		CMJ with Arms Thrust Take Off Speed (m/s)	

Criterion measures

- All the anthropometric measurements will be measured in $1/10^{th}$ of the centimeter. Non-stretchable measuring tape will be used to measure the length. Stadiometer will be used as a tool for measuring the height of the subjects.
- Standing broad jump and medicine ball throw will be measure with the help of measuring tape. The distance will be measure to the closest of $1/10^{th}$ of centimeter
- Shuttle run will be used for testing agility, and 50 yards for speed.
- Biomechanical variables will be measured with the help of BTS G-sensor.

PROCEDURE OF TESTING AND COLLECTION OF DATA

HEIGHT

It is the vertical distance from vertex to the horizontal floor. The subject is made to stand erect with both heels touching each other and the toes about 30^0apart, with hips and upper scapular part touching the wall while stretching upward and looking forwardinF.H. plane. Anthropometer rod is held vertically in front of the subject in mid sagittal plane. The horizontal moveable arm is brought down to the point vertex.

ARM LENGTH

It is the distance between acromion point and dectylion point. The subject will be asked to stand in a comfortable position. One end of the anthropometer will be fixed at acromion point and the anthropometer was adjusted up to dectylion point. The reading was recorded up to nearest 1/10 centimeter.

LEG LENGTH

The distance between the anterior superior iliac and the standing surface was measured with the anthropometer rod with the subject in the same position as that for stature.

FOOT LENGTH

To measure the straight distance of foot will be needed ananthropometer Rod. It is the distance between the tip of the most tarsal phalange and the most posterior part of the calcaneus. The measurement was taken with the help of Anthropometer Rod. The subject

was asked to stand in a comfortable position with feet slightly apart. Result will be recorded from the reading scale of anthropometer rod in centimeter.

SPEED (50 YARD DASH)

For this test, three stopwatches and an appropriate running space for the 50-yard run, as well as an extension for halting, were employed. The subjects were instructed to stand immobile (hands not touching the ground) behind the specified beginning line on the ground, one foot in front of the other. The test consists of doing a single maximal sprint over 50 yards and recording the timing. The individuals were instructed to warm up, including some practice starts and accelerations. Once the subject is ready and unmoving, the starter says "set" and then "go". The tester gave tips for maximizing speed (such as staying low and driving hard with the arms and legs), and the participants were encouraged not to slow down until they crossed the finish line. Each participant will be given two tries, with the best time recorded to the closest two decimal places. The timing begins with the initial movement (by a timer) and ends when the chest crosses the finish line.

.

AGILITY (SHUTTLE RUN)

The Shuttle Run was used to determine speed and agility. This exam will be conducted using equipment such as wooden blocks, marker cones, measurement tape, timer, and a nonslip surface. The subjects were instructed to stand immobile (hands not touching the ground) behind the specified beginning line on the ground, one foot in front of the other. This test demands individuals to sprint back and forth between two parallel lines as quickly as feasible. The testing area was marked with two lines of cones 30 feet apart, and three balls were placed behind one of the lines.Starting at the line opposite to the block on the signal "Ready Go!" the subject runs to the other line, picks up a ball and returns to place it behind the starting line, then returns to pick up the second ball, then runs quickly and places it behind the starting line, finally the subject returns to pick the third ball and runs with it back.

SHOULDER EXPLOSIVE STRENGTH (MEDICINE BALL PUT TEST)

This test will be used to measure arm and shoulder girdle strength, as well as shoulder explosive strength. The subjects will be given the following instructions before beginning the test: the medicine ball will not be thrown, but will be placed as demonstrated. The equipment required for this test is a 5 kg medicine ball, depending on the age group being tested, and a

tape measure.The subjects will be asked to stand between the two restraining lines and throw the ball straight down the course with their throwing arm. Each subject will be given three trials, and the distance from the starting position to where the ball lands will be recorded to the nearest tenth of a centimeter. The best result of the three throws will be used.

EXPLOSIVE STRENGTH OF LEGS

Standing Broad Jump: This item began with the subject standing behind a starting line with his feet several inches apart and the toes just behind the takeoffline. Preparatory to jumping, the subject swung his arms backward and bent his knees. The jump was accomplished by simultaneously extending the knees and swinging the arms forward. Three trials were allowed and the best was recorded in feet and inches.

CMJ with Arms Thrust (CMJAT)

The subject begins the test in upright position with the feet shoulder width apart and arms by their sides. Once the operator gives the command to start, the subject jumps by doing a countermovement towards down bending his/her knees by 90° with the help of his/her arms. During the entire course of the test, the trunk should remain upright.

STATISTICAL TECHNIQUE

The data of present study will be analyzed by using the following statistical techniques:

1. Descriptive statistics will be computed for obtaining general idea of performance at selected predictor variables. Under this mean, standard deviation, skewness and kurtosis will be computed.
2. Discriminant analysis will be used to classify an individual into one of the two categories on the basis of predictor variables.

EXPECTED OUTCOME

.

The research would provide a discriminant model for classifying long jumpers and 100m sprinters and this research will be helpful in talent identification for long jumpers and sprinters. This study would be helpful for coach and physical education teachers The present study will help athletics professionals in figuring out the most important predictor variables which have maximum discriminant power.If such discrimination is done at the early stage of training the future athletes could attain new heights in the international arena.The present study can be highly beneficial to Track and Field coaches in designing theseparate training program for sprinters and jumpers.

REFERENCES

- Guennadi, G. (1990) *Anhropomeric and physical fitness parameters of high jumpers of different age groups.* Scientific journal, SAI, NSNIS Patiala. 13 (4) pp. 9-10.
- Chauhan, M.S (2003) *Prediction of sprinting ability of Haryana school boys in relation to their Anthropometric measurements,* Journal of sports, and sports science, NSNIS Patiala, vol.21 no. 1.
- Chauhan M.S. (2004) *Prediction of performance of university throwers in relation to their anthropometric measurements,* Journal of sports, and sports science, NSNIS Patiala, vol.27 no. 3. .
- Durnin, JV.G.A. & Rehaman, M.M. (1967) *the assessment of the amount of fat in the human body from measurement of skin fold thickness*, British Journal of Nutrition. Vol. 21, no. 681.
- Singh Karanjit, Singh P., Singh C., & Sahib Bir (2012) *Anthropometric characteristics, Body composition and somatotyping of high and low performer shot putters,* Semantic scholar.
- Singh Kuldeep (2019) *Comparison of kinanthropometric parameters and body composition between sprinters and throwers*, International Journal of Yogic, Human Movement and Sports Sciences.
- Abraham George (2010) *Analysis of anthropometry, body composition and performance variables of young Indian athletes in southern region,* Indian Journal of Science and Technology. 3(12) pp. 1210-1213.
- T.J. Housh, W.G. Thorland, G.O. Johnson, G.D. Tharp & C.J. Cisar (2007) *Anthropometric and body build variables as discriminators of event participation in adolescent male track and field athletes.* Journal of sports sciences. Vol.2 issue 1.
- Oloo Micky Olutende, Jasper Situma Wekesa, Edinah Sabiri Mogaka, Issah Wabuyabo Kweyu (2018) *Discriminant analysis of anthropometric and bio-motor variables among groups of male University Athletes in three Sports,* European journal of physical education and sports science. vol. 4 issue 12 pp. 92-103.
- N.W. Kusnanik, A Hariyanto, Y Herdyanto, A. Satia (2018) *Talent identification model for sprinter using discriminant factor,* the consortium of Asia-PacificEducation Unversities. 1-5.
- Hoare D. (2000) *Predicting success in junior elite Basketball players – The contribution of Anthropometric & Physiological Attributes,* Journal of science

medicine and Sports. 3, pp. 391-405.

- Tar Surendra (2004), Impact of Kinanthropometric variables and strength during ball throwing performance of handball players, Journal of global research and analysis 3(2) pp.249-257.
- Thapa, R. K., Kumar, A., & Sharma, D. (2020). *Effect of drop height on different parameters of drop jump amongsoccer players*.

- Hay, J. G., & Nohara, H. (1990). Techniques used by elite long jumpers in preparation for takeoff. Journal of biomechanics, 23(3), 229-239.

- McGinnis, P. M. (2013). *Biomechanics of Sport and Exercise* (2nd ed.). Human Kinetics.

- Baechle, T. R., & Earle, R. W. (2008). *Essentials of Strength Training and Conditioning* (3rd ed.). Human Kinetics.